

What is claimed is:

1 1. A method of forming sidewall spacers adjacent opposing vertical sides of  
2 a gate electrode, comprising:  
3 forming at least one gate electrode over a substrate;  
4 forming a first silicon oxide film conformally over the substrate and gate  
5 electrode from a combination of gases including bis-(tertiarybutylamino)silane  
6 and oxygen;  
7 forming a silicon nitride film conformally over the first silicon oxide film  
8 from a combination of gases including bis-(tertiarybutylamino)silane; and  
9 forming a second silicon oxide film over the silicon nitride film from a  
10 combination of gases including bis-(tertiarybutylamino)silane and oxygen.

2. The method of Claim 1, wherein forming the first silicon oxide film  
2 comprises providing one or more wafers in a furnace at a first temperature, and  
3 flowing BTBAS and oxygen into the furnace.

1 3. The method of Claim 2, wherein, forming the silicon nitride film, and the  
2 second silicon oxide film comprises keeping the one or more wafers in the  
3 furnace.

1    4.    The method of Claim 2, wherein forming the silicon nitride film comprises  
2    maintaining the one or more wafers in the furnace at a second temperature, and  
3    flowing BTBAS and NH<sub>3</sub> into the furnace.

*C1 sub & crossed*

1    5.    The method of Claim 4, wherein forming the second oxide film comprises  
2    maintaining the one or more wafers in the furnace at the first temperature and  
3    flowing BTBAS and oxygen into the furnace.

1    6.    The method of Claim 4, wherein the first temperature is in the range of  
2    550°C to 580°C, and the second temperature is in the range of 580°C to 600°C.

1    7.    The method of Claim 1, further comprising, prior to forming the film silicon  
2    nitride film and subsequent to forming the first oxide film, purging the furnace.

1    8.    The method of Claim 7, wherein purging the furnace comprises ceasing  
2    the flow of BTBAS and oxygen, and flowing N<sub>2</sub> into the furnace.

*C1 sub & crossed*

1    9.    The method of Claim 1, further comprising, prior to forming the second  
2    oxide film and subsequent to forming the silicon nitride film, purging the furnace.

1    10.   The method of Claim 9, wherein purging the furnace comprises ceasing  
2    the flow of BTBAS and NH<sub>3</sub>, and flowing N<sub>2</sub> into the furnace.

1 11. A method of forming a transistor, comprising:  
2 forming at least one gate electrode over a gate dielectric layer, the gate  
3 dielectric layer disposed on a substrate;  
4 depositing a first silicon oxide film conformally over the substrate and gate  
5 electrode from a combination of gases comprising bis-(tertiarybutylamino)silane  
6 and oxygen;  
7 depositing a silicon nitride film conformally over the first silicon oxide film  
8 from a combination of gases comprising bis-(tertiarybutylamino)silane and  
9 ammonia;  
10 depositing a second silicon oxide film over the silicon nitride film from a  
11 combination of gases comprising bis-(tertiarybutylamino)silane and oxygen; and  
12 forming a first sidewall spacer.

1 12. The method of Claim 11, wherein the first silicon oxide, the silicon nitride,  
2 and the second silicon oxide are deposited in-situ.

1 13. The method of Claim 11, wherein depositing the first silicon oxide, the  
2 silicon nitride, and the second silicon oxide are all done in a first furnace.

1 14. The method of Claim 13, wherein the first furnace is vertically oriented  
and the BTBAS, oxygen, nitrogen, and ammonia, each flow into the furnace from  
a bottom of the vertically oriented furnace.

1    15. The method of Claim 11, further comprising implanting dopants to form a  
2    of deep source/drain region in the substrate adjacent at least two opposing sides  
3    of the gate electrode.

1    16. The method of Claim 14, wherein forming a first sidewall spacer  
2    comprises anisotropically etching the second silicon oxide layer, the silicon  
3    nitride layer, and the first silicon oxide layer.

*C3 C4* 17. The method of Claim 16, further comprising removing the second oxide  
layer so as to form L-shaped spacers.

1    18. The method of Claim 17, further comprising implanting dopants to form a  
2    deep source/drain region in the substrate, adjacent to each opposing side of the  
3    L-shaped spacers.

*SUB C4* 19. The method of Claim 17, wherein implanting dopants includes a partial  
2    passage of ions from an ion beam through a portion of the L-shaped spacers.

1    20. A field effect transistor, comprising:  
2       a gate electrode overlying a gate dielectric layer disposed on a substrate;  
3       a pair of L-shaped spacers adjacent opposing vertical sidewalls of the  
4       gate electrode; and

5            a pair of source/drain regions disposed in the substrate and aligned,  
6    respectively, adjacent to the pair of L-shaped spacers;  
7            wherein each of the source/drain regions has a shallow tip portion  
8    underlying each L-shaped spacer, a deep portion spaced away from the L-  
9   shaped spacer, and an intermediate portion having a depth greater than that of  
10   the shallow tip portion and less than that of the deep portion.

1        21. The field effect transistor of Claim 20, wherein each L-shaped spacer  
2    comprises a silicon oxide layer immediately adjacent to the gate electrode.

1        22. The field effect transistor of Claim 21, wherein each L-shaped spacer  
2    comprises a silicon nitride layer adjacent to the silicon oxide layer.

1        23. The field effect transistor of Claim 22, wherein the silicon nitride layer is  
2    thicker than the silicon oxide layer.